Preliminary Report on the Response of the Efferent Cells to the Odor Stimulation

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17. 匂い刺激に対する遠心性細胞の応答に関する予報

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嗅覚受容器官で，匂い刺激に対する遠心性神経の応答はまだほとんど調べられていない．本実験ではワモンゴキブリ触角から遠心性の神経応答と考えられるものを記録した．これらの神経は種々の匂い物質に対し，それぞれ異なる反応スペクトルを示した．

Introduction

Very few reports have been published concerning the olfactory responses from efferent cells of antennae, or in the nose of vertebrate. This communication is concerned with the successful extracellular recording of olfactory responses of efferent cells in the antenna.

Method

The american cockroach (Periplaneta americana), bred in the laboratory, were used. The insects were secured with adhesive tapes and wire hooks on a cork plate so that the head and antennae could not be moved. The olfactory receptors on the antenna were stimulated by the direct injection of the saturated odor vapor into a stream of purified air. The amplification and recording system was the same as that described earlier[1]. The glass pipettes (different electrode) was put on a sensory hair of one antenna, while the indifferent electrode is placed on another antenna, or on the same antenna.

Results and Discussion

Most units showed little or no spontaneous

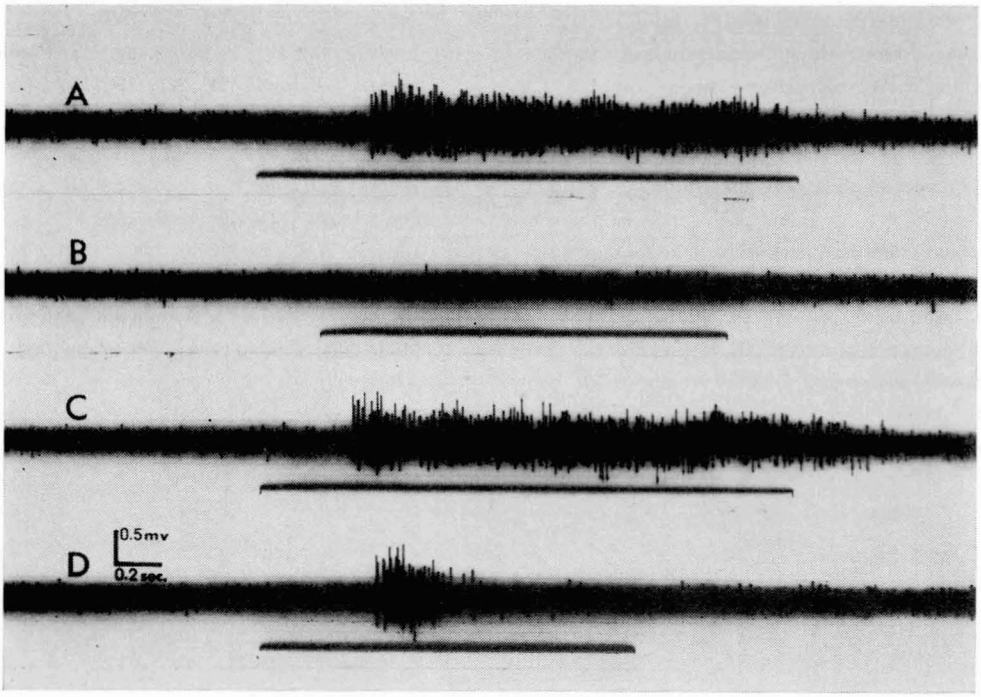


Fig. 1. Responses of efferent cells to odor stimuli.
A, Mentone; B, Geraniol; C, Eucalyptol; D, Butyric acid.

discharge, but some fired spontaneously. Olfactory stimuli either induce an impulse frequency increase, or produce no response at all. Judging from the irregular spike heights, the responses may have been derived from more than one cell.

Figure 1 shows a typical record of the activity of units when the antenna of American cockroach was stimulated qualitatively with a series of odor compounds.

As seen in Fig. 1A and B there is an increased activity when the stimulation of odor is turned on, and this activity was maintained throughout the stimulation. However, the cells stimulated by *n*-Butyric acid produced only an initial burst

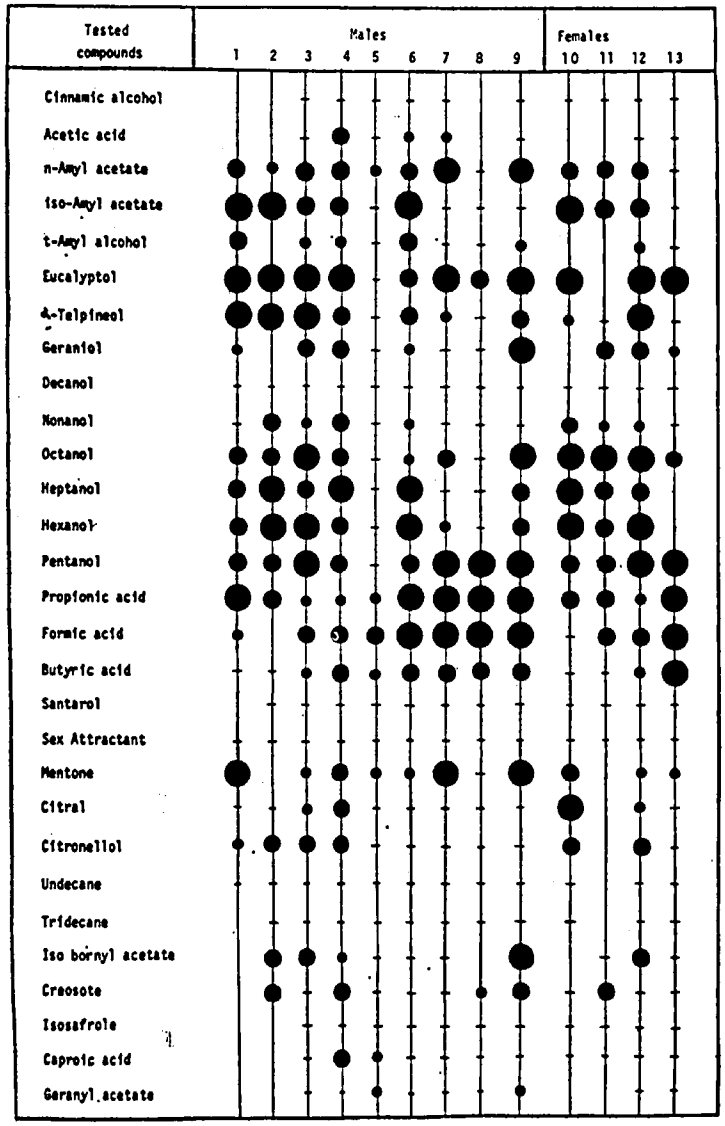
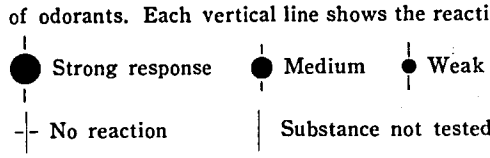


Fig. 2. Reaction spectra of efferent cells to an arbitrarily chosen set of odorants. Each vertical line shows the reaction of one cell.



of discharges despite continuous stimulation. Geraniol had no effect on the cells. It should be noted here that the cells did not respond equally to the every odor stimulation tested.

Figure 2 shows the summary of the reactions of the units tested in both sexes to an arbitrarily chosen set of odorants. The spectra of the units overlap considerably, but there is still some spectral variability from cell to cell. For example, unit numbers 1, 3, 4, 6, 7, 9, 10, 11, 12 are very similar to each other, but not exactly the same. From these results, it is obvious that the cells in the antenna possess some degree of specific sensitivity to odor stimuli. In the olfactory lobe of the cockroach, excitation (impulse frequency increase during stimulation) and inhibition (impulse frequency decrease) are known to be components of the odor response pattern[2]. However, the inhibitory responses has not been recorded from the efferent cells of this insects. Of the highest interest to the present discussion is the indications of the activities of the presumed efferent cells: (1) The responses to odor stimuli disappeared when the antenna was amputated from its base, although both different and indifferent electrode were placed on the same place of the antenna as before amputating antenna; (2) A burst of discharge could also be produced by the light illumination. (3) Even when odor stimuli were applied to distant regions of antenna from the places of recording electrodes, we can usually record big responses.

Though these experiments are still preliminary, the above-mentioned results strongly indicate that the electrophysiological responses to odor and light stimuli could be derived from efferent neurons.

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References

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2) Yamada, M.: *Nature*, 217, 778 (1968).

Effect of Alkaline and Acid Solutions on Insecticidal Activity of *Bacillus thuringiensis*. Junko Nishiitsutsuji-Uwo and Ayako Ohsawa (Shionogi Research Laboratory, Shionogi & Co., Ltd., Fukushima-ku, Osaka 553) Received April 8, 1975. *Botyu-Kagaku*, 40, 96, 1975. (with English Summary 102)

18. *Bacillus thuringiensis* の殺虫毒性におよぼす酸，アルカリの影響

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Bacillus thuringiensis の殺虫毒性を検定する場合，アルカリ性溶液を用いると毒性が著しく低下する事実に，われわれは度々遭遇した．BT がりん翅目昆虫に特異的に毒性を発揮するのは，腸管内の pH がアルカリ性であることが必須条件の一つとされており，かつ，この毒素を可溶化しうる溶液の代表の一つは強アルカリ性溶液であるとされている．それにもかかわらず，アルカリ性溶液で殺虫活性が低下，時に消失するのは，大きな矛盾のように思われた．そこで，BT var. *aizawai* を対象に，NaOH および KOH と酢酸をアルカリと酸の代表としてえらび，濃度・処理時間・pH 等を種々に組合わせて，BT 殺虫活性におよぼす影響をしらべた．その結果以下のことが判明した．① 酢酸は殺虫活性に影響を与えない．② NaOH や KOH は濃度が高い程，また処理時間が長い程活性の低下または消失をきたす．0.01 M の低濃度でさえ，長時間処理すると活性は低下する．③ NaOH で低下または消失した活性は中和，または透析によっても回復しない．④ NaOH による活性の低下は NaOH の濃度よりも，むしろ溶液の pH に依存するものであり，活性を低下させる臨界 pH は11-12である．

Bacillus thuringiensis（以下 BT と略す）は芽胞細菌であり，菌体内に δ-toxin と呼ばれるタンパク性の毒素結晶体を生成する．この結晶体を食下した場合，りん翅目こん虫のみが特異的に死ぬのは，腸管内の pH がアルカリ性(>pH 8.9) であることが大きな要因であるとされている．事実，この毒素は水，酸および有機溶媒に不溶であり，一般にアルカリ，もしくはアルカリと SH 試薬による可溶化が試みられている[1,2,3]．